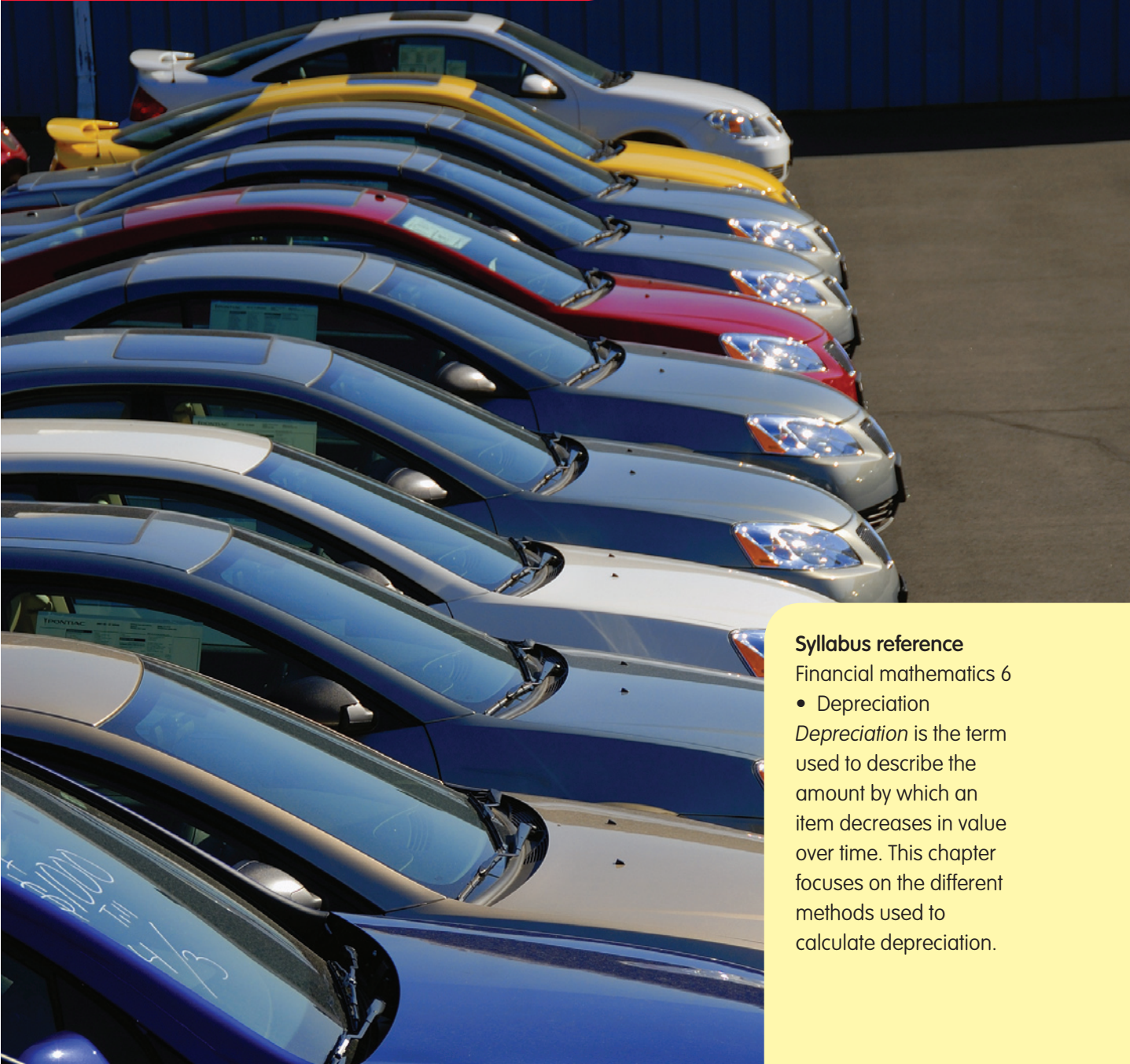


- 10A Modelling depreciation
- 10B Straight line depreciation
- 10C Declining balance method of depreciation
- 10D Depreciation tables

Depreciation



Syllabus reference

Financial mathematics 6

- Depreciation

Depreciation is the term used to describe the amount by which an item decreases in value over time. This chapter focuses on the different methods used to calculate depreciation.

ARE YOU READY?

Try the questions below. If you have difficulty with any of them, extra help can be obtained by completing the matching SkillsHEET. Either click on the SkillsHEET icon next to the question on the *Maths Quest HSC Course* eBookPLUS or ask your teacher for a copy.

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Digital doc
SkillsHEET 10.1
doc-1397
Graphing
linear
equations

Graphing linear equations

- 1 Draw the graphs of the following equations.
a $y = 2x - 1$ **b** $y = 8 - 4x$

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Digital doc
SkillsHEET 10.2
doc-1398
Graphing
exponential
functions

Graphing exponential functions

- 2 Draw the graphs of the following equations for $x \geq 0$.
a $y = 2^x$ **b** $y = (0.8)^x$ **c** $y = 5(\frac{1}{2})^x$

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SkillsHEET 10.3
doc-1399
Solving linear
equations

Solving linear equations

- 3 Solve the equations.
a $7x - 5 = 79$ **b** $3000x - 500 = 12\,500$ **c** $6000 - 500x = 3500$

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Digital doc
SkillsHEET 10.4
doc-1401
Calculating
compound
interest

Calculating compound interest

- 4 Calculate:
a the amount to which \$10 000 will grow at 6% p.a. over 5 years with interest compounded annually
b the amount to which \$50 000 will grow at 8.2% p.a. over 4 years with interest compounded six-monthly.

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doc-1406
Reading
financial
tables

Reading financial tables

- 5 The table below shows the amount to which \$1 will grow under compound interest.

Periods	Interest rate per period			
	6%	7%	8%	9%
1	1.060	1.070	1.080	1.090
2	1.123	1.145	1.166	1.188
3	1.191	1.225	1.260	1.295
4	1.262	1.311	1.360	1.412

Use the table to find:

- a** the amount to which \$10 000 will grow at 7% p.a. over 4 years with interest compounded annually.
b the amount to which \$50 000 will grow at 12% p.a. over 2 years with interest compounded six-monthly.

10A Modelling depreciation

An **asset** is an item that has value to its owner. Many assets such as cars and computers lose value over time. This is called **depreciation**.

Consider the case of a new motor vehicle. The value of the car depreciates the moment that you drive the car away from the showroom. This is because the motor vehicle is no longer new and if it were sold, it would have to be sold as a used car. The car then continues to lose value steadily each year.

Depreciation of motor vehicles

Choose a make of car and find out the price for a new vehicle of this make and model. Look through NRMA's *Open Road* magazine or the classified advertisements in the newspaper to find the price of the same model as a second-hand car.

Age of car (years)	Price
New (0)	
1	
2	
3	
4	
5	

Draw a graph that shows the price of this car as it ages.

There are two types of depreciation: the **straight line method** and the **declining balance method**. The straight line method is where the asset depreciates by a constant amount each year. When this type of depreciation is graphed, a straight line occurs and the asset will reduce to a value of 0.

In such a case, a linear function can be derived that will allow us to calculate the value of the item at any time. The function can be found using the gradient–intercept method. The purchase price of the asset (V_0) will be the vertical intercept, and the gradient will be the negative of the amount that the item depreciates, D , each period. The equation of this linear function will be:

$$V = V_0 - Dn$$

where V is the salvage value of the item and n is the age of the asset, in years.

Note: Gradients for depreciation will always be negative.

WORKED EXAMPLE 1

The table below shows the declining value of a computer. Graph the value against time and write an equation for this function.

Age (years)	Value (\$)
New (0)	4000
1	3500
2	3000
3	2500
4	2000
5	1500

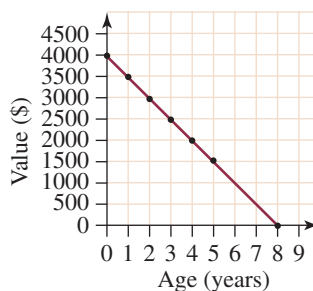


THINK

- 1 Draw a set of axes with age on the horizontal axis and value on the vertical.
- 2 Plot each point given by the table.
- 3 Join all points to graph the function.

- 4 Write the initial value as V_0 and use the gradient to state D .
- 5 Write the equation using $V = V_0 - Dt$.

WRITE



$$V_0 = 4000, D = 500$$

$$V = V_0 - Dt$$

$$V = 4000 - 500t$$

In worked example 1, how long does it take for the computer to depreciate to a value of \$0? The computer is said to be *written off* when it reaches this value.

The other method of depreciation used is the declining balance method of depreciation. Here, the value of the item depreciates each year by a percentage of its current value. Under such depreciation, the value of the item never actually becomes zero. This type of depreciation is an example of exponential decay that we saw in chapter 9.

WORKED EXAMPLE 2

The table below shows the value of a car that is purchased new for \$40 000.

Age of car (years)	Value (\$)
New (0)	40 000
1	32 000
2	25 600
3	20 480
4	16 384
5	13 107

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Tutorial
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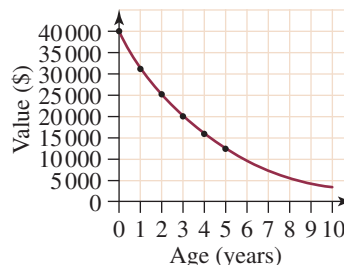
Worked example 2

Plot the points on a set of axes and graph the depreciation of the car. Use the graph to estimate the value of the car after 10 years.

THINK

- 1 Draw a set of axes with age on the horizontal axis and value on the vertical.
- 2 Plot the points from the table.
- 3 Join the points with a smooth curve.

WRITE



- 4 Estimate the value after 10 years from the graph you have drawn.

From the graph, the approximate value of the car after 10 years is \$4000.

REMEMBER

1. Depreciation is the loss in the value of an item over time.
2. Depreciation can be of two types:
 - (a) *Straight line depreciation.*
The item loses a constant amount of value each year
 - (b) *Declining value depreciation.*
The value of an item depreciates by a percentage of its value each year.
3. Straight line depreciation can be graphed using a linear function in which the new value of the item is the vertical intercept and the gradient is the negative of the annual loss in value.
4. Declining value depreciation is an example of exponential decay and is graphed with a smooth curve.

EXERCISE

10A Modelling depreciation

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Graphing
linear
equations

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Graphing
exponential
functions

- 1 WE1** The table below shows the depreciating value of a tractor.

Age (years)	Value (\$)
New (0)	100 000
1	90 000
2	80 000
3	70 000
4	60 000
5	50 000



- a Draw a graph of the value of the tractor against the age of the tractor.
 - b Write a function for the value of the tractor.
- 2** The table below shows the depreciating value of a tow truck.

Age (years)	Value (\$)
New (0)	50 000
1	42 000
2	34 000
3	26 000
4	18 000
5	10 000

Draw a graph of value against age; hence, write a value as a linear function of age.

- 3** The function $V = 50\,000 - 6000A$ shows the value, V , of a car when it is A years old.
- a Draw a graph of this function.
 - b Use the graph to calculate the value of the car after 5 years.
 - c After how many years would the car be written off?

- 4 A computer is bought new for \$6400 and depreciates at the rate of \$2000 per year.
- Write a function for the value, V , of the computer against its age, A .
 - Draw the graph of this function.
 - After how many years does the computer become written off?
- 5 **WE2** The table below shows the declining value of a new motorcycle.

Age (years)	Value (\$)
New (0)	20 000
1	15 000
2	11 250
3	8450
4	6350
5	4750

- Plot the points shown by the table, and draw a graph of the value of the motorcycle against age.
 - Use your graph to estimate the value of the motorcycle after 8 years. Give your answer correct to the nearest \$1000.
- 6 The table below shows the declining value of a semi-trailer.

Age (years)	Value (\$)
New (0)	600 000
1	420 000
2	295 000
3	205 000
4	145 000
5	100 000

- Plot the points as given in the table, and then draw a curve of best fit to graph the depreciation of the semi-trailer.
- Use your graph to estimate the value of the semi-trailer after 10 years.
- After what number of years will the value of the semi-trailer fall below \$50 000?

- 7 a A gymnasium values its equipment at \$200 000. Each year the value of the equipment depreciates by 20% of the value of the previous year. Calculate the value of the equipment after:
- 1 year
 - 2 years
 - 3 years
 - 4 years.



- Plot these points on a set of axes and draw a graph of the value of the equipment against its age.

8 MC Which of the tables below shows a straight line depreciation?

A

Age (years)	Value (\$)
New (0)	4000
1	3600
2	3240
3	2916
4	2624
5	2362

B

Age (years)	Value (\$)
New (0)	4000
1	3600
2	3200
3	2800
4	2400
5	2000

C

Age (years)	Value (\$)
New (0)	4000
1	3600
2	3300
3	3100
4	3000
5	2950

D

Age (years)	Value (\$)
New (0)	4000
1	3000
2	2500
3	1500
4	1000
5	500

9 A car is bought new for \$30 000.

- a** The straight line method of depreciation sees the car lose \$4000 in value each year. Complete the table below.

Age (years)	Value (\$)
New (0)	30 000
1	
2	
3	
4	
5	

- b** Draw a graph of this depreciation.
- c** The declining balance method of depreciation sees the value of the car fall by 20% of the previous year's value. Complete the table below.

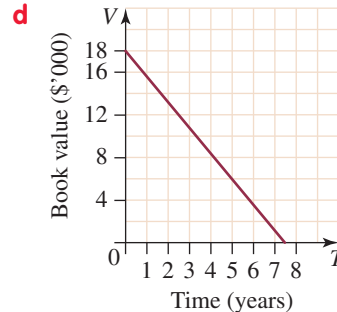
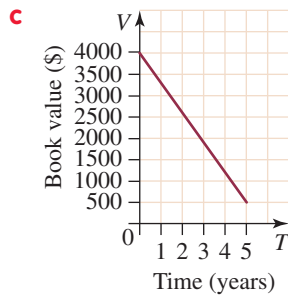
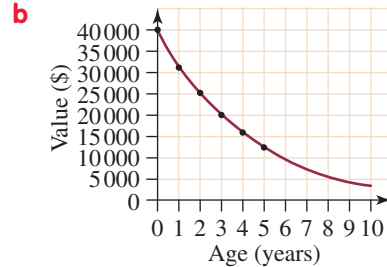
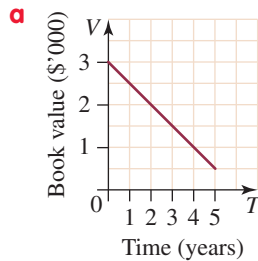
Age (years)	Value (\$)
New (0)	30 000
1	
2	
3	
4	
5	

- d** On the same set of axes draw a graph of this depreciation.
- e** After how many years is the car worth more under declining balance depreciation than under straight line depreciation?

Further development

10 Each of the graphs below shows a straight line depreciation. In each case determine:

- i the cost price of the item
- ii the amount by which the item depreciates each year
- iii the time taken for the item to be written off (reach a value of \$0).



11 **MC** Listed below are the depreciation equations for four different items. Which item would be written off in the least amount of time?

- A $S = 14\,000 - 1500n$
- B $S = 12\,000 - 1300n$
- C $S = 12\,000 - 1500n$
- D $S = 12\,000 - 1700n$

12 **MC** Listed below are the depreciation equations for four different items. Which item would be written off in the most amount of time?

- A $S = 25\,000 - 2000n$
- B $S = 25\,000 - 2500n$
- C $S = 22\,500 - 2000n$
- D $S = 22\,500 - 2500n$

13 **MC** A car valued at \$30 000 was bought 5 years ago for \$67 500. The straight line depreciation model is represented by:

- A $S = 67\,500 - 30\,000n$
- B $S = 67\,500 - 7500n$
- C $S = 67\,500 - 6000n$
- D $S = 67\,500 - 30\,000n$

14 A business buys two different computers at the same time. Computer A costs \$4400 and is to be depreciated by \$450 per annum. This computer can be written off when the value falls to \$800. Computer B costs \$7200 and is to be depreciated by \$620 per annum and is written off when the value falls to \$1100.

- a Which computer would need to be replaced first?
- b How much later would the other computer need to be replaced?

15 A printing firm chose to depreciate its \$52 000 printing press by the straight line method. After 6 years the value of the printing press fell below \$6400. It was then written off.

What was the annual amount of depreciation?

10B Straight line depreciation

We have already seen that the method of straight line depreciation is where the value of an item depreciates by a constant amount each year. The depreciated value of an item is called the **salvage value**, S . The salvage value of an asset can be calculated using the formula:

$$S = V_0 - Dn$$

where V_0 is the purchase price of the asset, D is the amount of depreciation apportioned per period and n is the number of periods.

WORKED EXAMPLE 3

A laundry buys dry-cleaning equipment for \$30 000. The equipment depreciates at a rate of \$2500 per year. Calculate the salvage value of the equipment after 6 years.



THINK

- 1 Write the formula.
- 2 Substitute the values of V_0 , D and n .
- 3 Calculate the value of S .

WRITE

$$\begin{aligned} S &= V_0 - Dn \\ &= \$30\,000 - \$2500 \times 6 \\ &= \$15\,000 \end{aligned}$$

By solving an equation we are able to calculate when the value of an asset falls below a particular amount.

WORKED EXAMPLE 4

A plumber purchases equipment for a total of \$60 000. The value of the equipment is depreciated by \$7500 per year. When the value of the equipment falls below \$10 000 it should be replaced. Calculate the number of years after which the equipment should be replaced.

THINK

Method 1: Technology-free

- 1 Write the formula.
- 2 Substitute for S , V_0 and D .
- 3 Solve the equation to find the value of n .
- 4 Give a written answer, taking the value of n up to the next whole number.

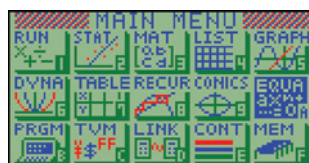
WRITE

$$\begin{aligned} S &= V_0 - Dn \\ 10\,000 &= 60\,000 - 7500n \\ 7500n &= 50\,000 \\ n &= 6\frac{2}{3} \end{aligned}$$

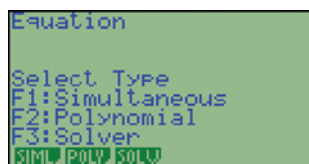
The equipment must be replaced after 7 years.

Method 2: Technology-enabled

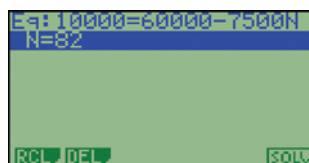
1 From the **MENU** select **EQUA**.



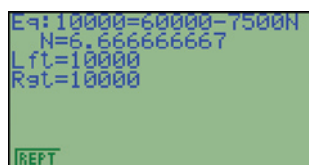
2 Press **F3** (**Solver**).



3 Delete any existing equation, and enter the equation that arises after the substitution is made.
Note: You may have a different value of N , but at this stage this can be ignored.



4 Press **F6** (**SOLV**) to solve the equation.



REMEMBER

1. Straight line depreciation occurs when the value of an asset depreciates by a constant amount each year.
2. The formula to calculate the salvage value, S , of an asset is:

$$S = V_0 - Dn$$

where V_0 is the purchase price of the asset, D is the amount of depreciation apportioned per period and n is the total number of periods.

3. To calculate a value of V_0 , D or n we substitute all known values and solve the equation that is formed.

EXERCISE

10B Straight line depreciation

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Solving
linear
equations

- 1 **WE3** A car that is purchased for \$45 000 depreciates by \$5000 each year. Calculate the salvage value of the car after 5 years.
- 2 Calculate the salvage value:
 - a after 5 years of a computer that is purchased for \$5000 and depreciates by \$800 per year
 - b after 7 years of a motorbike that is purchased for \$25 000 and depreciates by \$2100 per year
 - c after 6 years of a semi-trailer that is purchased for \$750 000 and depreciates by \$80 000 per year
 - d after 2 years of a mobile phone that is purchased for \$225 and depreciates by \$40 per year
 - e after 4 years of a farmer's plough that is purchased for \$80 000 and depreciates by \$12 000 per year.

- 3 A bus company buys 15 buses for \$475 000 each.
 - a Calculate the total cost of the fleet of buses.
 - b If each bus depreciates by \$25 000 each year, calculate the salvage value of the fleet of buses after 9 years.
- 4 The price of a new car is \$25 000. The value of the car depreciates by \$300 each month. Calculate the salvage value of the car after 4 years.
- 5 **WE4** An aeroplane is bought by an airline for \$600 million. If the aeroplane depreciates by \$40 million each year, calculate when the value of the aeroplane falls below \$300 million.
- 6 Calculate the length of time for each of the following items to depreciate to the value given.
 - a A computer purchased for \$5600 to depreciate to less than \$1000 at \$900 per year
 - b An electric guitar purchased for \$1200 to depreciate to less than \$500 at \$150 per year
 - c An entertainment unit purchased for \$6000 to become worthless at \$750 per year
 - d Office equipment purchased for \$12 000 to depreciate to less than \$2500 at \$1500 per year
- 7 A motor vehicle depreciates from \$40 000 to \$15 000 in 10 years. Assuming that it is depreciating in a straight line, calculate the annual amount of depreciation.
- 8 Calculate the annual amount of depreciation in an asset that depreciates:
 - a from \$20 000 to \$4000 in 4 years
 - b from \$175 000 to \$50 000 in 10 years
 - c from \$430 000 to \$299 500 in 9 years.
- 9 A computer purchased for \$3600 is written off in 4 years. Calculate the annual amount of depreciation.
- 10 A car that is 5 years old has an insured value of \$12 500. If the car is depreciating at a rate of \$2500 per year, calculate its purchase price.
- 11 Calculate the purchase price of each of the following assets given that:
 - a after 5 years the value is \$50 000 and is depreciating at \$12 000 per year
 - b after 15 years the value is \$4000 and is depreciating at \$1500 per year
 - c after 25 years the value is \$200 and is depreciating at \$50 per year.
- 12 An asset that depreciates at \$6500 per year is written off after 12 years. Calculate the purchase price of that asset.

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Further development

- 13 A winery chose to depreciate a bottling machine, which cost \$27 000 when new, by the straight line method. The annual depreciation was \$4000 and its useful life was 6 years.
 - a What was the salvage value of the corking machine at the end of its useful life?
 - b Draw a graph to show the depreciation of the bottling machine.
- 14 Machinery is bought for \$31 000 and depreciated by the straight line method. The amount of depreciation each year is 20% of the cost price.
 - a Find the annual depreciation.
 - b Write a formula for the salvage value of the item in terms of the age of the item.
 - c The machinery will be written off when the value falls below \$6200. Find how long it will take for the item to be written off.
- 15 A building company buys a bobcat for \$69 000 and depreciates it by the straight line method. The item is depreciated by 15% of the cost price each year. The item is written off for tax purposes when its value falls below \$6900.
 - a Find the annual depreciation
 - b Write a formula for the salvage value of the item in terms of the age of the item.
 - c Find how long it will take for the item to be written off.

- 16** The prime cost method of depreciation is a form of straight line depreciation, where the amount of the annual depreciation is a percentage of the initial cost. The owner of a rental property chooses to depreciate the carpets, which were purchased for \$6000, by the prime cost method. The annual depreciation is 17% of the cost price per year.
- Find the annual depreciation.
 - Write a formula for the salvage value of the item in terms of the age of the item.
 - Use it to find how long it will take for the item to be written off.
- 17** For the situations described below, and using the straight line depreciation model, find:
- the annual rate of depreciation
 - the length of time for the item to be written off.
 - A car purchased for \$40 000 four years ago, now with a current value of \$20 000
 - A stereo unit bought for \$1700 seven years ago, now with a current value of \$300
 - A refrigerator bought for \$1729 10 years ago, now with a current value of \$399
 - An aeroplane with a purchase price of \$304 000 sold at market value for \$101 250 when it was 8 years old
- 18** A writer has a home office that forms 12% of the total area of his house. The house was bought for \$450 000.
- Calculate the amount of the purchase price that can be assigned to the home office.
 - The home office can be depreciated using the prime cost method at the rate of 4% of the purchase price. Calculate the annual amount of depreciation allowed on the home office.
 - Calculate the salvage value of the home office 8 years after purchase.

10C Declining balance method of depreciation

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Interactivity

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Reducing
balance
depreciation

The declining balance method of depreciation occurs when the value of an asset depreciates by a given percentage each period.

Consider the case of a car purchased new for \$30 000, which depreciates at the rate of 20% p.a. Each year the salvage value of the car is 80% of its value at the end of the previous year.

$$\begin{aligned}
 \text{After 1 year: } S &= 80\% \text{ of } \$30\,000 \\
 &= \$24\,000 \\
 \text{After 2 years: } S &= 80\% \text{ of } \$24\,000 \\
 &= \$19\,200 \\
 \text{After 3 years: } S &= 80\% \text{ of } \$19\,200 \\
 &= \$15\,360
 \end{aligned}$$

WORKED EXAMPLE 5

A small truck that was purchased for \$45 000 depreciates at a rate of 25% p.a. By calculating the value at the end of each year, find the salvage value of the truck after 4 years.

THINK

- The salvage value at the end of each year will be 75% of its value at the end of the previous year.
- Find the value after 1 year by calculating 75% of \$45 000.
- Find the value after 2 years by calculating 75% of \$33 750.

WRITE

$$\begin{aligned}
 \text{After 1 year: } S &= 75\% \text{ of } \$45\,000 \\
 &= \$33\,750 \\
 \text{After 2 years: } S &= 75\% \text{ of } \$33\,750 \\
 &= \$25\,312.50
 \end{aligned}$$

- 4 Find the value after 3 years by calculating 75% of \$25 312.50.
- 5 Find the value after 4 years by calculating 75% of \$18 984.38.

$$\begin{aligned}\text{After 3 years: } S &= 75\% \text{ of } \$25\,312.50 \\ &= \$18\,984.38\end{aligned}$$

$$\begin{aligned}\text{After 4 years: } S &= 75\% \text{ of } \$18\,984.38 \\ &= \$14\,238.28\end{aligned}$$

The salvage value under a declining balance can be calculated using the formula:

$$S = V_0(1 - r)^n$$

where S is the salvage value, V_0 is the purchase price, r is the percentage depreciation per period expressed as a decimal and n is the number of periods.

This formula can be considered as being similar to the compound interest formula. In the case of depreciation, however, you need to subtract rather than add the depreciation expressed as a decimal from 1.

WORKED EXAMPLE 6

The purchase price of a boat is \$15 000. The value of the boat depreciates by 10% p.a. Calculate the salvage value of the boat after 8 years.

THINK

- 1 Write the formula.
- 2 Substitute values for V_0 , r and n .
- 3 Calculate the salvage value.

WRITE

$$\begin{aligned}S &= V_0(1 - r)^n \\ &= \$15\,000 \times 0.9^8 \\ &= \$6457.00\end{aligned}$$

To calculate the amount by which the asset has depreciated, we subtract the salvage value from the purchase price.

WORKED EXAMPLE 7

The purchase price of a motor vehicle is \$40 000. The vehicle depreciates by 12% p.a. Calculate the amount by which the vehicle depreciates in 10 years.

THINK

- 1 Write the formula.
- 2 Substitute the value of V_0 , r and n .
- 3 Calculate the value of S .
- 4 Calculate the amount of depreciation by subtracting the salvage value from the purchase price.

WRITE

$$\begin{aligned}S &= V_0(1 - r)^n \\ &= \$40\,000 \times 0.88^{10} \\ &= \$11\,140.04 \\ \text{Depreciation} &= \$40\,000 - \$11\,140.04 \\ &= \$28\,859.96\end{aligned}$$

REMEMBER

1. The declining method of depreciation occurs when the value of an asset depreciates by a fixed percentage each year.
2. The salvage value of an asset can be calculated by subtracting the percentage depreciation each year.



3. The salvage value can be calculated using the formula:

$$S = V_0(1 - r)^n$$

where S is the salvage value, V_0 is the purchase price, r is the percentage depreciation per period expressed as a decimal and n is the number of periods.

4. To calculate the amount of depreciation, the salvage value should be subtracted from the purchase price.

EXERCISE

10C

Declining balance method of depreciation

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Calculating
compound
interest

- 1 **WES** The purchase price of a forklift is \$50 000. The value of the forklift depreciates by 20% p.a. By calculating the value of the forklift at the end of each year, find the salvage value of the forklift after 4 years.
- 2 A trailer is purchased for \$5000. The value of the trailer depreciates by 15% each year. By calculating the value of the trailer at the end of each year, calculate:
- the salvage value of the trailer after 5 years (to the nearest \$10)
 - the amount by which the trailer depreciates:
 - in the first year
 - in the fifth year.

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SkillsSHEET 10.5
doc-1402
Finding a
percentage
of a quantity
(money)

- 3 A company purchases a mainframe computer for \$3 000 000. The value of the computer depreciates by 15% p.a. By calculating the value at the end of each year, find the number of years that it takes for the salvage value of the mainframe to fall below \$1 000 000.
- 4 **WE6** Use the formula $S = V_0(1 - r)^n$ to calculate the salvage value after 7 years of a power generator purchased for \$800 000 that depreciates at a rate of 10% p.a. (Give your answer correct to the nearest \$1000.)
- 5 Calculate the salvage value of an asset (correct to the nearest \$100) with a purchase price of:
- \$10 000 that depreciates at 10% p.a. for 5 years
 - \$250 000 that depreciates at 15% p.a. for 8 years
 - \$5000 that depreciates at 25% p.a. for 5 years
 - \$2.2 million that depreciates at 30% p.a. for 10 years
 - \$50 000 that depreciates at 40% p.a. for 5 years.
- 6 A plumber has tools and equipment valued at \$18 000. If the value of the equipment depreciates by 30% each year, calculate the value of the equipment after 3 years.
- 7 **WE7** A yacht is valued at \$950 000. The value of the yacht depreciates by 22% p.a. Calculate the amount that the yacht will depreciate in value over the first 5 years (correct to the nearest \$1000).
- 8 A new car is purchased for \$35 000. The owner plans to keep the car for 5 years and then trade the car in on another new car. The estimate is that the value of the car will depreciate by 16% p.a. Calculate:
- the amount the owner can expect as a trade in for the car in 5 years (correct to the nearest \$100)
 - the amount by which the car will depreciate in 5 years.



- 9 **MC** A shop owner purchases fittings for her store that cost a total of \$120 000. Three years later, the shop owner is asked to value the fittings for insurance. If the shop owner allows for depreciation of 15% on the fittings, which of the following calculations will give the correct estimate of their value?
- A $120\,000 \times 0.85^3$ B $120\,000 \times 0.15^3$
 C $120\,000 \times 0.55$ D $120\,000 \times 0.45$
- 10 **MC** A computer purchased for \$3000 will depreciate by 25% p.a. The salvage value of the computer after 4 years will be closest to:
- A \$0 B \$10 C \$950 D \$2000
- 11 An electrician purchases tools of trade for a total of \$8000. Each year the electrician is entitled to a tax deduction for the depreciation of this equipment. If the rate of depreciation allowed is 33%, calculate:
- a the value of the equipment at the end of one year (correct to the nearest \$1)
 b the tax deduction allowed in the first year
 c the value of the equipment at the end of two years (correct to the nearest \$1)
 d the tax deduction allowed in the second year.
- 12 An accountant purchased a computer for \$6000. The value of the computer depreciates by 33% p.a. When the value of the computer falls below \$1000, it is written off and a new one is purchased. How many years will it take for the computer to be written off?

Further development

- 13 A farming company chose to depreciate its new \$90 000 bulldozer by the declining balance method at a rate of 20% p.a.
- a Write an expression for the salvage value of the bulldozer in terms of the age of the bulldozer.
 b Copy and complete the table below.

Time (years)	Depreciation (\$)	Salvage value (\$)
0	—	90 000
1		
2		
3		
4		

- c What is the salvage value after 6 years?

- 14 A retail store chose to depreciate its new \$6000 computer by the declining balance method at a rate of 40% p.a.
- a Copy and complete the table below (called a depreciation schedule).

Time (years)	Depreciation (\$)	Value (\$)
0	—	6000
1		
2		
3		
4		

- b What is its salvage value after 5 years?
 c Find the number of years taken for the salvage value to fall below \$150.

- 15 A plumber chose to depreciate a set of tools, valued at \$4500, by the declining balance method at a rate of 40% p.a. Draw a depreciation schedule for the first 4 years of the tool set's life.
- 16 An accounting firm chose to depreciate a set of new electronic calculators, valued at \$2000 in total, by the declining balance method at a rate of 25% p.a. of the previous salvage value.

- a** Draw a depreciation schedule for the first 4 years of the set's life.
 - b** Find the number of years that it takes for the value of the calculators to fall below \$400, at which point they can be written off for tax purposes.
- 17** A newsagency buys a cash register for \$1650. The owner has the choice of depreciating the register by the straight line method (at 20% of the cost price each year) or the reducing balance method (at 30% of the previous salvage value each year).
- a** Draw depreciation schedules for both methods for a life of 5 years.
 - b** After how many years does the reducing balance salvage value become greater than the flat rate salvage value?
- 18** Black Cabs taxi service has bought a new taxi for \$60 000. The company has the choice of depreciating the taxi by the flat rate method (at $33\frac{1}{3}\%$ of the cost price each year) or the declining balance method (at 50% of the previous book value each year).
- a** Draw depreciation schedules for both methods for 3 years.
 - b** After how many years does the declining balance book value become greater than the straight line book value?

10D Depreciation tables

The computer application below will prepare a table that will show the depreciated value of an asset with a purchase price of \$1 over various periods of time and various rates of depreciation.

Computer Application 1: Depreciation table

- Open a new spreadsheet and enter the following information.
- In cell **B3** enter the formula = $(1 - B\$3)^{A\$4}$.
- Highlight the range of cells **B4** to **K23**. Then use the **Edit** and then the **Fill** and **Right** and **Fill** and **Down** functions to copy the formula throughout the table.
- The table that you now have should have the values shown in the table below.

The table produced by the computer application shows the depreciated value of \$1 and can be used to make calculations about depreciation.

Depreciated value of \$1										
Period	Rate of depreciation (per annum)									
	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
1	0.9500	0.9000	0.8500	0.8000	0.7500	0.7000	0.6500	0.6000	0.5500	0.5000
2	0.9025	0.8100	0.7225	0.6400	0.5625	0.4900	0.4225	0.3600	0.3025	0.2500
3	0.8574	0.7290	0.6141	0.5120	0.4219	0.3430	0.2746	0.2160	0.1664	0.1250
4	0.8145	0.6561	0.5220	0.4096	0.3164	0.2401	0.1785	0.1296	0.0915	0.0625
5	0.7738	0.5905	0.4437	0.3277	0.2373	0.1681	0.1160	0.0778	0.0503	0.0313
6	0.7351	0.5314	0.3771	0.2621	0.1780	0.1176	0.0754	0.0467	0.0277	0.0156
7	0.6983	0.4783	0.3206	0.2097	0.1335	0.0824	0.0490	0.0280	0.0152	0.0078
8	0.6634	0.4305	0.2725	0.1678	0.1001	0.0576	0.0319	0.0168	0.0084	0.0039
9	0.6302	0.3874	0.2316	0.1342	0.0751	0.0404	0.0207	0.0101	0.0046	0.0020
10	0.5987	0.3487	0.1969	0.1074	0.0563	0.0282	0.0135	0.0060	0.0025	0.0010
11	0.5688	0.3138	0.1673	0.0859	0.0422	0.0198	0.0088	0.0036	0.0014	0.0005
12	0.5404	0.2824	0.1422	0.0687	0.0317	0.0138	0.0057	0.0022	0.0008	0.0002

(continued)

Period	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
13	0.5133	0.2542	0.1209	0.0550	0.0238	0.0097	0.0037	0.0013	0.0004	0.0001
14	0.4877	0.2288	0.1028	0.0440	0.0178	0.0068	0.0024	0.0008	0.0002	0.0001
15	0.4633	0.2059	0.0874	0.0352	0.0134	0.0047	0.0016	0.0005	0.0001	0.0000
16	0.4401	0.1853	0.0743	0.0281	0.0100	0.0033	0.0010	0.0003	0.0001	0.0000
17	0.4181	0.1668	0.0631	0.0225	0.0075	0.0023	0.0007	0.0002	0.0000	0.0000
18	0.3972	0.1501	0.0536	0.0180	0.0056	0.0016	0.0004	0.0001	0.0000	0.0000
19	0.3774	0.1351	0.0456	0.0144	0.0042	0.0011	0.0003	0.0001	0.0000	0.0000
20	0.3585	0.1216	0.0388	0.0115	0.0032	0.0008	0.0002	0.0000	0.0000	0.0000

WORKED EXAMPLE 8

An item is purchased for \$500 and depreciates at a rate of 15% p.a. Use the depreciation table on pages 328–9 to calculate the value of the item after 4 years.

THINK

- Look up the table to find the depreciated value of \$1 at 15% p.a. for 4 years.
- Multiply the depreciated value of \$1 by \$500.

WRITE

$$\text{Depreciated value} = 0.5220 \times \$500 \\ = \$261$$

The computer application on pages 328–9 will produce a general table for a declining balance depreciation. We should be able to use the formula to create a table and graph showing the salvage value of an asset under both straight line and declining balance depreciation.

WORKED EXAMPLE 9

A car is purchased new for \$20 000. The depreciation can be calculated under straight line depreciation at \$2500 per year and under declining balance at 20% p.a.

- a Complete the table below. (Give all values to the nearest \$1.)

Age of car (years)	Straight line value (\$)	Declining balance value (\$)
New (0)	20 000	20 000
1		
2		
3		
4		
5		
6		
7		
8		

- b Draw a graph of both the straight line and declining balance depreciation and use the graph to show the point at which the straight line value of the car falls below the declining balance value.

THINK

- a
- Copy the table.
 - Complete the straight line column by subtracting \$2500 from the previous year's value.

WRITE

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int-2437

Worked example 9

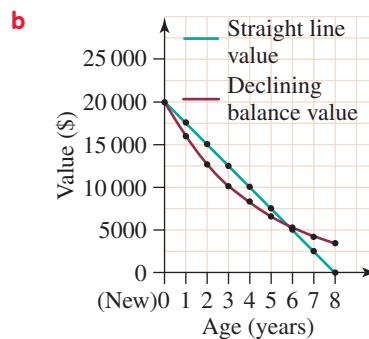
- 3 Complete the declining balance by multiplying the previous year's value by 0.8.

- b
- 1 Plot the points generated by the table.
 - 2 Join the points for the straight line depreciation with a straight line.
 - 3 Join the points for the declining balance depreciation with a smooth curve.

- 4 The graph shows the straight line going below the curve after 6 years.

a

Age of car (years)	Straight line value (\$)	Declining balance value (\$)
New (0)	20 000	20 000
1	17 500	16 000
2	15 000	12 800
3	12 500	10 240
4	10 000	8 192
5	7 500	6 554
6	5 000	5 243
7	2 500	4 194
8	0	3 355



The straight line depreciation value becomes less than the declining balance depreciation value after 6 years.

Depreciation is an allowable tax deduction for people in many occupations. A tax deduction for depreciation is allowed when equipment used in earning an income depreciates in value and will eventually need replacing. Depending on the equipment and the occupation, either straight line or declining balance depreciation may be used.

Under declining balance depreciation, when the salvage value falls below a certain point the equipment may be written off. This means that the entire remaining balance can be claimed as a tax deduction and as such is considered worthless. From this point on, no further tax deductions can be claimed for this equipment.

WORKED EXAMPLE 10

A builder has tools of trade that are purchased new for \$14 000. He is allowed a tax deduction of 33% p.a. for depreciation of this equipment. When the salvage value of the equipment falls below \$3000, the builder is allowed to write the equipment off on the next year's return. Complete the depreciation table below. (Use whole dollars only.)

Years	Salvage value (\$)	Tax deduction (\$)
1		
2		
3		
4		
5		

THINK

- 1 Calculate the salvage value by multiplying the previous year's value by 0.67.
- 2 Calculate the tax deduction by multiplying the previous year's value by 0.33.
- 3 When the salvage value is less than \$3000, claim the entire amount as a tax deduction.

WRITE

Year	Salvage value (\$)	Tax deduction (\$)
1	9380	4620
2	6285	3095
3	4211	2074
4	2821	1390
5	0	2821

REMEMBER

1. Graphs can be drawn to compare the salvage value of an asset under different rates of depreciation, or to compare declining balance and straight line depreciation.
2. The amount by which an asset depreciates can, in many cases, be claimed as a tax deduction.

EXERCISE**10D Depreciation tables****eBookplus****Digital doc**

SkillSHEET 10.5
doc-1402

Finding a
percentage
of a quantity
(money)

- 1 **WE8** Use the table of depreciated values of \$1 to calculate:
 - a the value of a computer purchased for \$5000 after 5 years, given that it depreciates at 20% p.a.
 - b the value of a car after 8 years with an initial value of \$35 000, given that it depreciates at 15% p.a.
 - c the value of a boat with an initial value of \$100 000 after 10 years, given that it depreciates at 10% p.a.
- 2 **WE9** A taxi owner purchases a new taxi for \$40 000. The taxi depreciates under straight line depreciation at \$5000 per year and under declining balance depreciation at 20% p.a.
 - a Copy and complete the table below. Give all values to the nearest \$100.

Age of car (years)	Straight line value (\$)	Declining balance value (\$)
New (0)	40 000	40 000
1		
2		
3		
4		
5		
6		
7		
8		

eBookplus**Digital doc**

SkillSHEET 10.6
doc-1404

Reading
financial
tables

eBookplus**Digital doc**

SkillSHEET 10.7
doc-1405

Increase or
decrease by
a percentage

- b** Draw a graph of the salvage value of the taxi under both methods of depreciation.
- c** State when the value under straight line depreciation becomes less than under declining balance depreciation.
- 3** A company has office equipment that is valued at \$100 000. The value of the equipment can be depreciated at \$10 000 each year or by 15% p.a.
- a** Draw a table that will show the salvage value of the office equipment for the first ten years using both methods. (Give all values correct to the nearest \$50.)
- b** Draw a graph of the depreciating value of the equipment under both methods of depreciation.
- 4** A computer purchased new for \$4400 can be depreciated at either 20% p.a. or 35% p.a. Draw a table and a graph that compare the salvage value of the computer at each rate of depreciation over a 6-year period.
- 5** **WEIO** A teacher purchases a laptop computer for \$6500. A tax deduction for depreciation of the computer is allowed at the rate of 33% p.a. When the value of the computer falls below \$1000, the computer can be written off. Copy and complete the table below. (Give all values correct to the nearest \$1.)

Year	Salvage value (\$)	Tax deduction (\$)
1		
2		
3		
4		
5		
6		

- 6** A plumber purchases a work van for \$45 000. The van can be depreciated at a rate of 25% p.a. for tax purposes, and the van can be written off at the end of 8 years. Copy and complete the depreciation schedule below. (Give all answers correct to the nearest \$1.)

Year	Salvage value (\$)	Tax deduction (\$)
1		
2		
3		
4		
5		
6		
7		
8		

- 7** A truck is purchased for \$250 000. The truck can be depreciated at the rate of \$25 000 each year or over 10 years at 20% p.a.

- a** Copy and complete the table below. (Give all values correct to the nearest \$1.)

Age of truck (years)	Straight line value (\$)	Declining balance value (\$)
New (0)	250 000	250 000
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

- b** Draw a graph of the depreciating value of the truck under both methods of depreciation.
c Complete a depreciation schedule for each method of calculation.
- 8** Tony is a plumber and on 1 March purchases a panel van for work purposes. The cost of the panel van is \$40 000, and for tax purposes the panel van depreciates at the rate of 25% p.a.
- a** Calculate the amount that the panel van will depreciate in the first year.
b The financial year ends on 30 June. For what fraction of the financial year did Tony own the panel van?
c Tony is allowed a tax deduction for depreciation of his work van. Calculate the amount of tax deduction that Tony is allowed for the financial year ending on 30 June.
- 9** Calculate the amount of depreciation on each of the following assets.
- a** A tractor with an initial value of \$80 000 that depreciates at 15% p.a. for 3 months
b A bicycle with an initial value of \$600 that depreciates at 25% p.a. for 6 months
c Office furniture with an initial value of \$8000 that depreciates at 30% p.a. for 8 months
d A set of encyclopedias with an initial value of \$2500 that depreciates at 40% p.a. for 9 months

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WorkSHEET 10.2
doc-1406

Further development

- 10** A \$15 000 printing press is depreciated at a rate of 20% p.a. Use the table on pages 328–9 to:
- a** determine the salvage value of the printing press after 7 years
b find the number of years it will take for the value of the printing press to fall to less than \$1000.
- 11** A bus company buys a new bus for \$560 000. The bus is depreciated by 15% p.a. Use the table on pages 328–9 to calculate:
- a** the value of the bus after 8 years
b the number of years that it would take for the value of the bus to fall to below 10% of its purchase price.
- 12** Use the table on pages 328–9 to determine the length of time that it will take an item to halve in value if it is depreciated at:
- a** 10% p.a. **b** 20% p.a. **c** 25% p.a.
- 13** The tax office will allow an item to be written off for tax purposes when its value falls below 20% of the initial cost. Use the table on page 000 to determine the number of years that this will take if the item is depreciated at:
- a** 10% p.a. **b** 15% p.a. **c** 25% p.a. **d** 40% p.a.

- 14** A photocopier purchased for \$8500 is depreciated at a rate of 17.5% p.a.
- a** Use the table on pages 328–9 to estimate the depreciated value of \$1 at 17.5% p.a. after 5 years.
 - b** Use your answer to part (a) to find the depreciated value of the photocopier after 5 years.
 - c** Find the amount by which the photocopier has depreciated after 5 years.
- 15** A delivery service purchases a delivery truck for \$100 000. The truck can be depreciated at a rate of 40% p.a.
- a** Use the table on pages 328–9 to calculate the amount to which the van depreciates in 2 years.
 - b** Use the table on pages 328–9 to calculate the total amount of depreciation in 3 years.
 - c** The van is sent to the wreckers for scrap metal when its value falls to less than \$1000.
How old will the van be when it is sent to the wreckers?

SUMMARY

Modelling depreciation

- Depreciation can be calculated in two ways. The depreciation can be straight line depreciation or declining balance depreciation.
- Straight line depreciation occurs when the value of an asset decreases by a constant amount each year. The graph of the salvage value is a straight line, the vertical intercept is the purchase price and the gradient is the negative of the annual depreciation.
- Declining balance depreciation occurs when the salvage value of the item is a percentage of the previous year's value. The graph of a declining balance depreciation will be an exponential decay graph.

Straight line depreciation

- The salvage value of an asset under straight line depreciation can be calculated using the formula:

$$S = V_0 - Dn$$

where S is the salvage value, V_0 is the purchase price of the asset, D is the amount of depreciation apportioned per period and n is the number of periods of depreciation.

- Values of V_0 , D or n can be calculated by substitution and solving the equation formed.

Declining balance method of depreciation

- Under declining balance depreciation the salvage value of an asset can be calculated using the formula:

$$S = V_0(1 - r)^n$$

where r is the percentage depreciation per period expressed as a decimal.

- To calculate the amount by which an asset depreciates in a year, we subtract the salvage value at the end of the year from the salvage value at the beginning of the year.

Depreciation tables

- Depreciation can be compared using either a table or a graph.
- Tax deductions are allowed for depreciation of assets that are used as part of earning an income.
- A depreciation schedule is used to calculate tax deductions over a period of years on an asset.

CHAPTER REVIEW

MULTIPLE CHOICE

- 1 Which of the following tables gives an example of declining balance depreciation?

A

Year	Salvage value
New (0)	20 000
1	18 000
2	16 200
3	14 580
4	13 122

B

Year	Salvage value (\$)
New (0)	20 000
1	18 200
2	16 400
3	14 600
4	12 800

C

Year	Salvage value
New (0)	20 000
1	18 000
2	16 500
3	15 500
4	15 000

D

Year	Salvage value (\$)
New (0)	20 000
1	17 000
2	15 000
3	14 000
4	13 500

- 2 A helicopter is purchased by a company for \$3.3 million. The salvage value of the helicopter depreciates in a straight line at a rate of \$240 000 per year. After how many years will the value of the helicopter be less than \$1 million?

A 8
B 9
C 10
D 11

- 3 Trevor purchases a new computer for \$5000. It depreciates under declining balance depreciation at a rate of 20% p.a. Each year Trevor claims the amount of depreciation on the computer as a tax deduction. The amount of Trevor's tax deduction in the third year is:

A \$640 **B** \$1000
C \$2560 **D** \$3200

- 4 The value of a new car depreciates by 12.5% p.a. The salvage value in 5 years of a car that was purchased new for \$37 500 is (to the nearest \$100):

A \$9375 **B** \$18 300
C \$19 200 **D** \$32 800

SHORT ANSWER

- 1 The table below shows the depreciating value of a pleasure cruiser.

Age (years)	Value (\$)
New (0)	200 000
1	180 000
2	160 000
3	140 000
4	120 000
5	100 000



- a** Draw a graph of the value of the pleasure cruiser against its age.
b Write a function for the value of the pleasure cruiser.

- 2** The table below shows the depreciating value of a racing bike.



Age (years)	Value (\$)
New (0)	3500
1	3250
2	3000
3	2750
4	2500
5	2250

- Draw a graph of the value of the bike against age.
 - Write a function for the straight line depreciation.
 - Use your graph to estimate the value of the bike after 9 years.
- 3** The function $V = 15\,000 - 900A$ shows the value, V , of a motorcycle when it is A years old.
- Draw a graph of this function.
 - Use the graph to calculate the value of the motorcycle after 5 years.
 - After how many years would the motorcycle be written off?

- 4** The table below shows the declining value of a delivery van.



Age (years)	Value (\$)
New (0)	60 000
1	48 000
2	38 400
3	30 720
4	24 576
5	19 660

- Plot the points as given in the table, and then draw a curve of best fit to graph the depreciation of the van.
 - Use your graph to estimate the value of the van after 10 years.
 - After what number of years will the value of the van fall below \$10 000?
- 5** A laundry buys dry-cleaning equipment for \$8000. Each year the equipment depreciates by 25% of the previous year's value. Calculate the value of the equipment at the end of the first five years, and use the results to draw a graph of the depreciation.



- 6 The purchase price of a car is \$32 500. The car depreciates by \$3250 each year. Use the formula $S = V_0 - Dn$ to calculate the salvage value of the car after 8 years.



- 7 Calculate the salvage value of an asset:
- a after 6 years, that was purchased for \$4000 and depreciates by \$450 each year
 - b after 10 years, that was purchased for \$75 000 and depreciates by \$6000 each year
 - c after 9 years, that was purchased for \$640 000 and depreciates by \$45 000 each year.
- 8 A movie projector is purchased by a cinema for \$30 000. The projector depreciates by \$2500 each year. Calculate the length of time it takes for the projector to be written off.
- 9 A camera that was purchased new for \$1500 has a salvage value of \$500 four years later. Calculate the annual amount of depreciation on the camera.
- 10 Arthur buys a car for \$25 000. The depreciation on the car is \$2250 each year. He decides that he will trade the car in on a new car in the final year before the salvage value falls below \$10 000. When will Arthur trade the car in?
- 11 The purchase price of a mobile home is \$40 000. The value of the mobile home depreciates by 15% p.a. By calculating the value of the mobile home at the end of each year, find the salvage value of the mobile home after 4 years. (Give your answer correct to the nearest \$1.)



- 12 Use the formula $S = V_0(1 - r)^n$ to calculate the salvage value after 7 years of a crop duster that was purchased for \$850 000 and depreciates at 8% p.a. (Give your answer correct to the nearest \$1000.)
- 13 Calculate the salvage value of an asset (correct to the nearest \$10) with a purchase price of:
- a \$40 000 that depreciates at 10% p.a. for 5 years
 - b \$1500 that depreciates at 4% p.a. for 10 years
 - c \$180 000 that depreciates at 12.5% p.a. for 15 years
 - d \$4.5 million that depreciates at 40% p.a. for 10 years
 - e \$250 000 that depreciates at $33\frac{1}{3}\%$ p.a. for 4 years.
- 14 A company buys a new bus for \$600 000. The company keeps buses for 10 years and then trades them in on a new bus. The estimate is that the value of the bus will depreciate by 12% p.a.



Calculate:

- a the amount the owner can expect as a trade-in for the bus in 10 years
 - b the amount by which the bus will depreciate in 10 years.
- 15 A company has office equipment that is valued at \$100 000. The value of the equipment can be depreciated at \$10 000 each year or by 15% p.a.
- a Draw a table to show the salvage value of the office equipment for the first ten years.
 - b Draw a graph of the depreciating value of the equipment under both depreciation methods.
- 16 A personal computer is purchased for \$4500. A tax deduction for depreciation of the computer is allowed at the rate of 33% p.a. When the value of the computer falls below \$1000, the computer can be written off. Copy and complete the table below.

Year	Salvage value (\$)	Tax deduction (\$)
1		
2		
3		
4		
5		

EXTENDED RESPONSE

- 1 The value of a home theatre system when purchased new is \$3000. The system depreciates at the rate of 15% p.a. under declining balance depreciation.
- a Calculate the salvage value of the system in 4 years (correct to the nearest \$1).
 - b By how much has the system depreciated in this time?
 - c Calculate the equivalent rate of straight line depreciation over the four years.
 - d Graph the salvage value of the home theatre system under both declining balance and straight line depreciation.



- 2 An office is fitted with \$200 000 of office equipment. The company claims tax deductions for the depreciation of the equipment at the rate of 12% p.a.
- a Calculate the amount of tax deduction claimed by the company in the first year.
 - b Complete the depreciation schedule below.

Year	Salvage value (\$)	Tax deduction (\$)
1		
2		
3		
4		
5		

- c When the value of the equipment falls below \$50 000, the equipment is written off and replaced. After how many years will the equipment be written off?

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Test Yourself
doc-1407
Chapter 10

Are you ready?**Digital docs** (page 314)

- SkillsSHEET 10.1 (doc-1397): Graphing linear equations.
- SkillsSHEET 10.2 (doc-1398): Graphing exponential functions.
- SkillsSHEET 10.3 (doc-1399): Solving linear equations.
- SkillsSHEET 10.4 (doc-1401): Calculating compound interest.
- SkillsSHEET 10.6 (doc-1404): Reading financial tables.

10A Modelling depreciation**Tutorial**

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